Fishery Leaflet
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ALASKA'S FISHERY RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

Fishery Leaflet 631

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Alaska's Fishery Resources

The Shrimps

By

LOUIS BARR

Fishery Leaflet 631

Washington, D.C.

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CONTENTS

	Page
Introduction	1
Identifying the species	1
Commercial species	2
Life history	2
Food	8
Predators	8
The domestic and foreign fisheries	8
Domestic fisheries	8
Foreign fisheries	8
Research	9
Literature cited	10

Alaska's Fishery Resources - The Shrimps

By

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ABSTRACT

Shrimp fishing began in Alaska over 50 years ago. Recently the annual domestic catch has been as high as 40 million pounds. Japanese and Soviet Union fishermen operating in Alaska waters have caught as much as 70 million pounds annually in recent years.

The five commercially important shrimp of Alaska belong to the family Pandalidae; the most important is the pink shrimp, Pandalus borealis.

The complicated life histories of these shrimp are all similar. The shrimp develop first as males and after several years transform to females, which they remain for the rest of their lives.

United States fishermen use otter trawls, beam trawls, and pots, and deliver their catch to ports in Alaska; foreign fishermen use larger otter trawls and process the catch at sea.

The Alaska Department of Fish and Game and the Bureau of Commercial Fisheries are studying shrimp. They are sampling the commercial catch, trying to improve the product, and conducting exploratory fishing and biological research.

INTRODUCTION

The shrimp resource of Alaska supports one of the State's leading fisheries and shows potential for great increases in the future. Domestic commercial fishing for shrimp in Alaska began more than 50 years ago. Foreign fisheries have also developed in the international waters along the Alaska coast--Japan began fishing in 1961 and Russia began in 1963. The combined domestic and foreign catch in 1963 reached a peak of 85 million pounds of whole shrimp. Yet even a catch of this size may be far below the potential. Exploratory fishing by the Bureau of Commercial Fisheries has revealed areas with unused concentrations of shrimp large enough to indicate a potential annual production of 145 million pounds to 600 million pounds of whole shrimp. The development of better pots and of trawls capable of fishing on rough bottoms will provide the means for harvesting shrimp from many areas that cannot now be fished.

The per capita consumption of shrimp in the United States has increased steadily in recent years--from about three-fourths of a pound of processed shrimp in 1950 to almost 1-1/2 pounds in 1968 (Lyles, 1969). As the consumption of shrimp increases, the demand for shrimp from Alaska also increases.

IDENTIFYING THE SPECIES

The commercial species of shrimp of Alaska are members of the family Pandalidae, which belongs to the decapod order of crustaceans. The name "decapod" refers to crustaceans having 10 "walking" legs, and it is by these legs that pandalid shrimp can be separated from other families. Each leg of the first, third, fourth, and fifth pairs has a sharply pointed tip; each leg of the second pair has a small pincer at its tip. Shrimp of all other families have a different arrangement of pointed and pincer-tipped legs.

The following key[1] can be used to identify the species of Alaska Pandalid shrimp. This key is used by selecting from the first pair of numbered descriptions the item that better fits the shrimp being identified. This initial selection

[1]This key modified from Butler's (1964) version of Rathbun's (1904) pandalid shrimp key.

leads either to identification of the shrimp or to selection of another item from another pair of numbered descriptions. Selections are made between succeeding pairs of descriptions until the shrimp in question is identified. Figure 1 illustrates the terms used in the key.

1. Antennules are twice the length of the carapace.----------
-------Sidestripe shrimp (Pandalopsis dispar)
Antennules are shorter than the carapace.----------2

2. Third segment of the abdomen is partly ridged. Ridge forms a lobe or spine in front of the posterior margin of the segment.-----3
Third segment of the abdomen not ridged, and there is neither a lobe nor a spine in front of the posterior margin.----------5

3. Third and fourth segments of the abdomen each have a median spine on the posterior margin.---------Pink shrimp (Pandalus borealis)
Third and fourth segments do not have median spines on posterior margin.---------4

4. Rostrum has spines on distal half of dorsal margin.--Ocean shrimp (Pandalus jordani)
Rostrum does not have spines on the distal half of the dorsal margin.----------
----------Humpy shrimp (Pandalus goniurus)

5. Dorsal spines are present behind middle of carapace.----------6
Dorsal spines not present behind middle of carapace.----------8

6. Dorsal spine count greater than 15 (17-21).
-----Coonstripe shrimp (Pandalus hypsinotus)
Dorsal spine count less than 15 (8-12).--7

7. Antennal scale is very narrow. The distal half of the blade of the antennal scale is narrower than the thickness of the adjacent spine.------
----------(Pandalus stenolepis)
Antennal scale is of moderate width. The distal half of the blade of the antennal scale is wider than the thickness of the adjacent spine.
----------Dock shrimp (Pandalus danae)

8. Sixth abdominal segment more than twice as long as wide.---------(Pandalus montagui)
Sixth abdominal segment is less than twice as long as wide.----------
----------Spot shrimp (Pandalus platyceros)

COMMERCIAL SPECIES

Although nine species of pandalid shrimp live in Alaska waters, only five (pink, sidestripe, humpy, coonstripe, and spot) are important in the commercial fishery (fig. 2). Table 1 gives some of the general characteristics of the five species.

The pink and sidestripe shrimp are the first and second most important species respectively in Alaska's commercial harvest. Although pink shrimp are one of the smallest species, they are so abundant that they usually make up 60 to 90 percent of the catch in trawls. The catches may be as large as 3,000 pounds per 1/2-hour tow. Sidestripe shrimp usually make up 10 to 20 percent of trawl catches of shrimp. Both species are important commercially because they are abundant and are found on smooth mud bottoms where they can be harvested easily with trawls.

Humpy and coonstripe shrimp occasionally make up significant portions of trawl catches, but their distributions are spotty and they contribute relatively little to the total landings of shrimp. In addition to those taken in trawls, coonstripe shrimp are often caught in pots in rocky untrawlable areas.

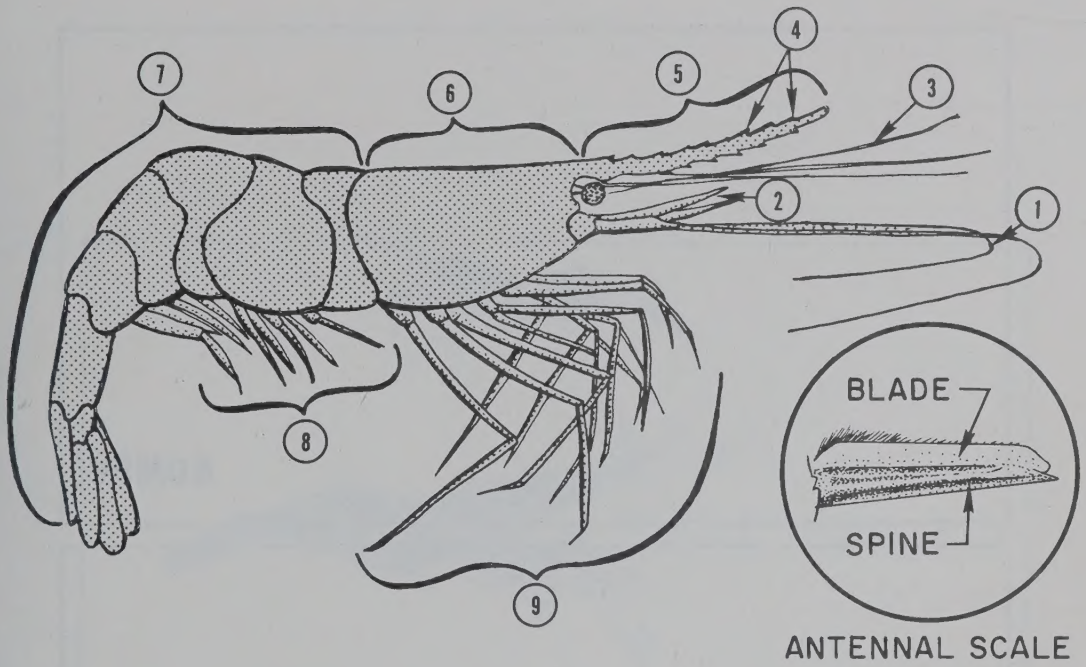
Spot shrimp are of only minor commercial importance in Alaska because they are difficult to catch. They are seldom abundant, except on untrawlable bottoms--rough rocky areas, often with sheer rock cliffs--where they are caught in pots. Although the fishing method is inefficient, small-scale pot fisheries for spot shrimp develop sporadically because of the high unit value of this large shrimp.

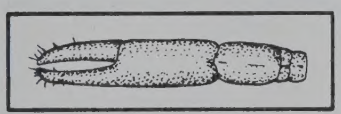
LIFE HISTORY

The life histories of the commercially important species of shrimp in Alaska are all similar; the pink shrimp is used as an example because most research has been devoted to this species. This section discusses what is known of the life cycle of pink shrimp from Kachemak Bay, Alaska (fig. 3), where the Bureau of Commercial Fisheries has a year-round shellfish research station.

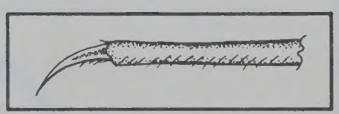
The developing eggs of pink shrimp are carried on the abdominal appendages of the females for about 6 months and hatch in March or April. The newly hatched shrimp, known as larvae, are about three-sixteenths of an inch long and are entirely different from the adults (figs. 2 and 4). The planktonic larvae drift passively or swim weakly at midwater depths where they feed on organisms smaller than themselves.

During the first 2 or 3 months after they hatch, the larvae molt (shed their outer skeleton or shell) about six times. With each molt they grow larger and become more like the adults in appearance. By early summer the larvae closely





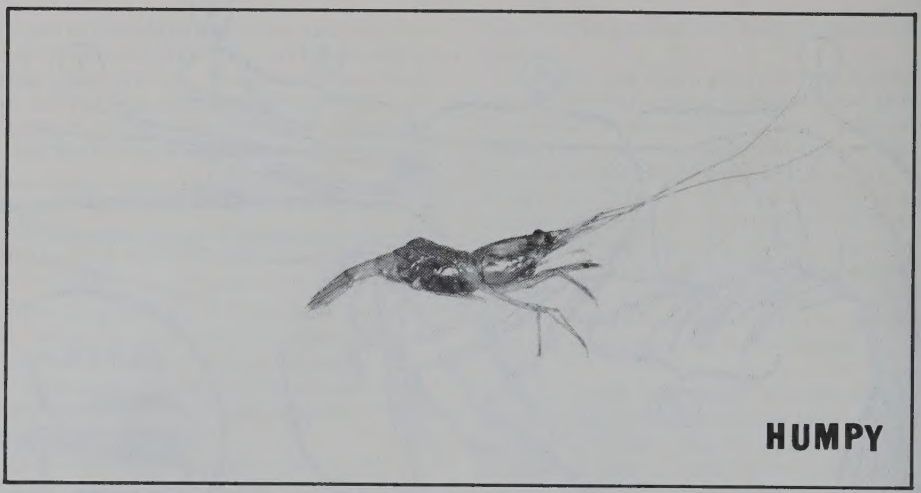
CHELATE OR PINCER-EQUIPPED LEGS



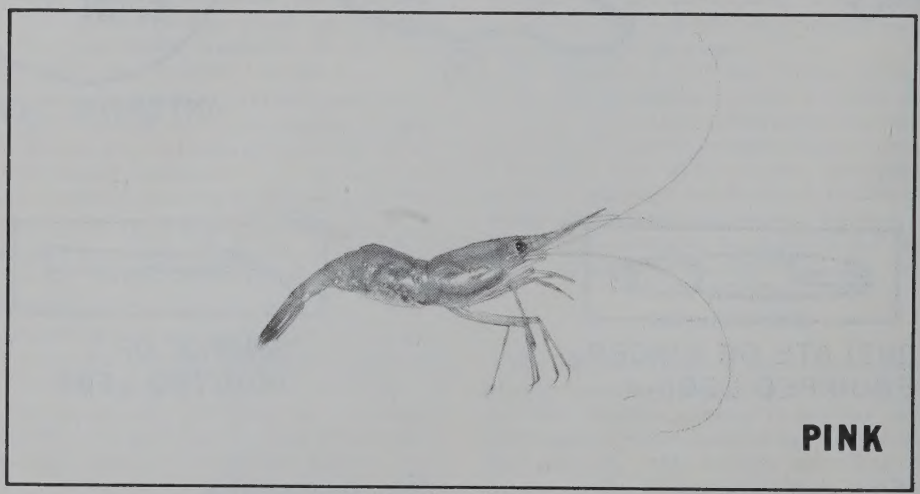
SIMPLE OR POINTED LEGS

1. ANTENNAS
2. ANTENNAL SCALE
3. ANTENNULES
4. DORSAL SPINES
5. ROSTRUM
6. CARAPACE
7. ABDOMEN
8. ABDOMINAL APPENDAGES (PLEOPODS)
9. WALKING LEGS (PEREIOPODS)

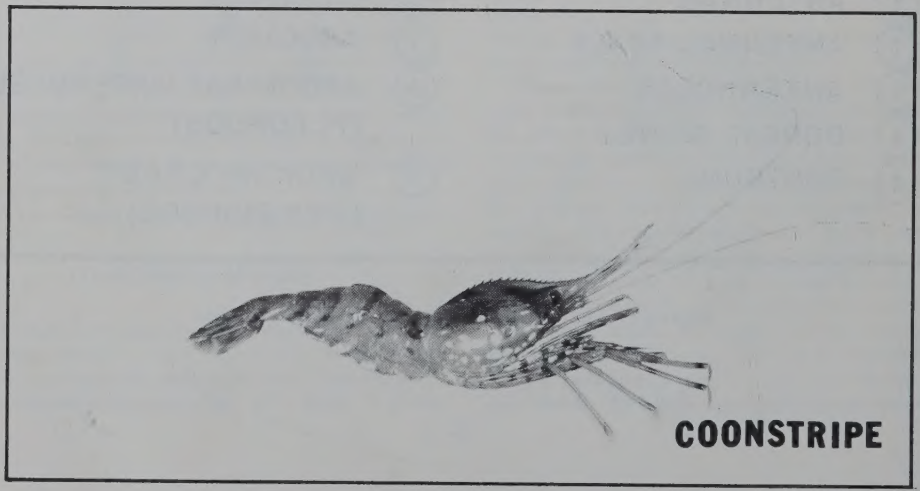
Figure 1.--External anatomy of a pandalid shrimp.



HUMPY



PINK



COONSTRIPE

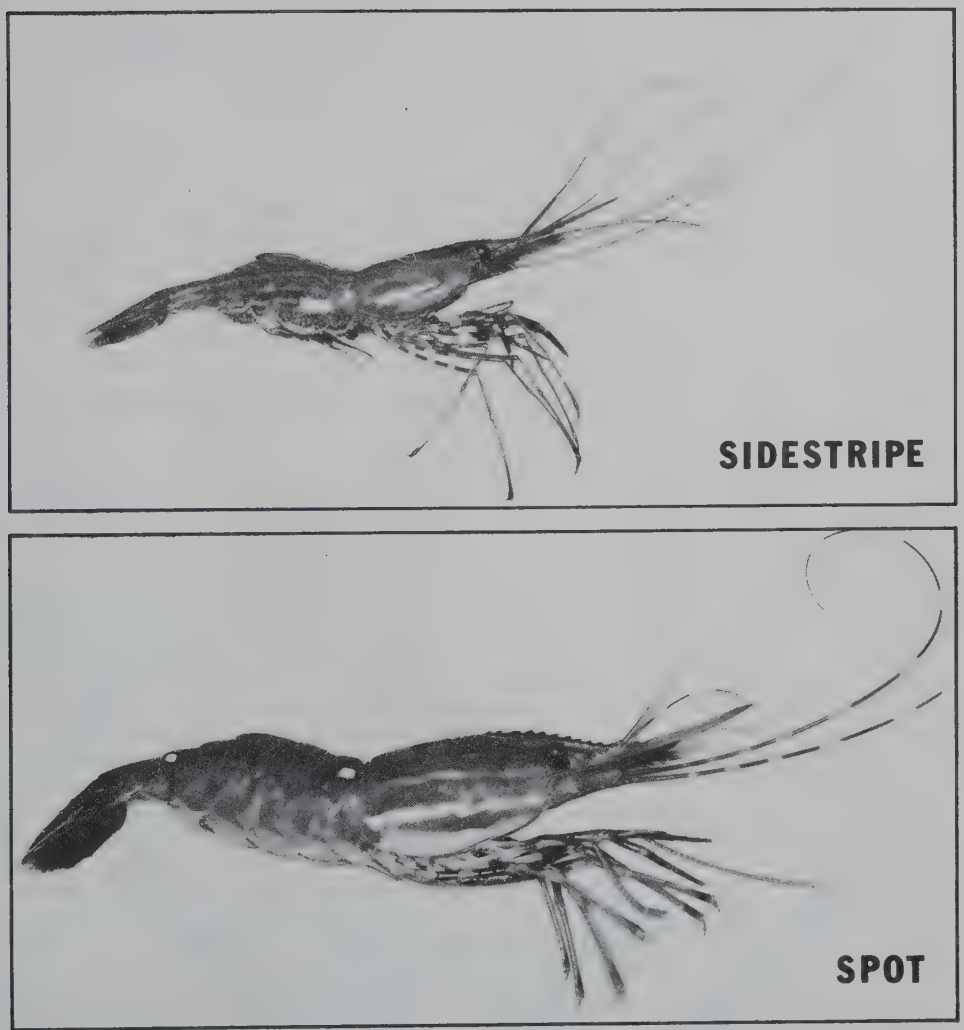


Figure 2.--The five species of shrimp important in Alaska's commercial fishery.

Table 1.--General characteristics of the five important species of Alaska shrimp

Species of shrimp	Approximate maximum size	Shrimp per pound	Geographic range in Alaska	Type of gear	Type of bottom	Usual depth of capture	Greatest depth of capture
	Inches	Number				Fathoms	Fathoms
Pink	6-1/2	60-160	Pribilof Islands-southeastern Alaska	Trawls	Smooth mud	20-100	350
Sidestripe	8-1/2	20-100	Central Bering Sea-southeastern Alaska	Trawls	Smooth mud	>20	350
Humpy	4-3/4	80-180	Bering Strait-southeastern Alaska	Trawls	Smooth mud, sand, organic debris	10-100	100
Coonstripe	8	30-100	Norton Sound-southeastern Alaska	Trawls, pots	Smooth mud, sand, rocky areas	25- 50	100
Spot	11	6- 25	Unalaska-southeastern Alaska	Pots	Rough, rocky	>30	266

resemble the adults, although they are still less than three-quarters of an inch long. As they change to the adult body form, they leave the plankton and take up the adult style of existence--standing or walking on the bottom or swimming above the bottom.

In Kachemak Bay, pink shrimp live at least 5 or 6 years, but most of their growth is completed in the first 4 years. They are almost 2 inches long when 1 year old, 3 inches when 2 years, 4 to 4-1/2 inches when 3 years, and 4-1/2 to 5 inches when 4 years. They rarely reach a length greater than 5-3/4 inches. With a few possible exceptions, the shrimp are males from the larval stage through their third or fourth year of life, but in the fourth or fifth year they transform to females. This change of sex, which is typical of the sexual development of most pandalid shrimp, occurs gradually as the animal goes through several molts. The transformation begins about March or April and may not be complete until August or September. Once the sex change is complete the individual remains a female the rest of its life. The result is a breeding population that normally has several age groups of shrimp, of which the younger are males and the older are females.

Spawning usually begins in late September and ends in mid-October. The males do not undergo any major external change during the reproductive season, but just before spawning the female molts into a shell specialized for carrying the eggs. A female in spawning shell has setae (hairlike structures) on the abdominal appendages which are longer and plates on the sides of the abdomen which are deeper than those of a nonspawning female.

Soon after the prespawning molt of the female, the shrimp mate and the eggs are deposited.[2] The male attaches a packet of sperm on the underside of the female, where the eggs will be fertilized. As the female extrudes the eggs through a pair of openings at the base of a pair of legs, the eggs are carried backward and attached to the setae on her abdominal appendages, where they are protected by the deep lateral abdominal plates. Fertilization takes place as the eggs pass across the sperm packet on their way to the abdominal appendages. The developing eggs remain attached to the setae until they hatch. Large females may produce 2,000 or more eggs at one spawning. The female does not molt or grow in the 5 to 6 months needed for the eggs to complete development and hatch, but about 2 weeks after the eggs hatch she molts and returns to her nonbreeding-type shell.

The eggs are still attached to the female when they hatch. During the hatching of her brood, which may take up to 2 days, the female stands on the bottom and vigorously "fans" the water

[2]The descriptions of mating and egg deposition are based on observations on Pandalus danae reported by A. B. Needler (1931).

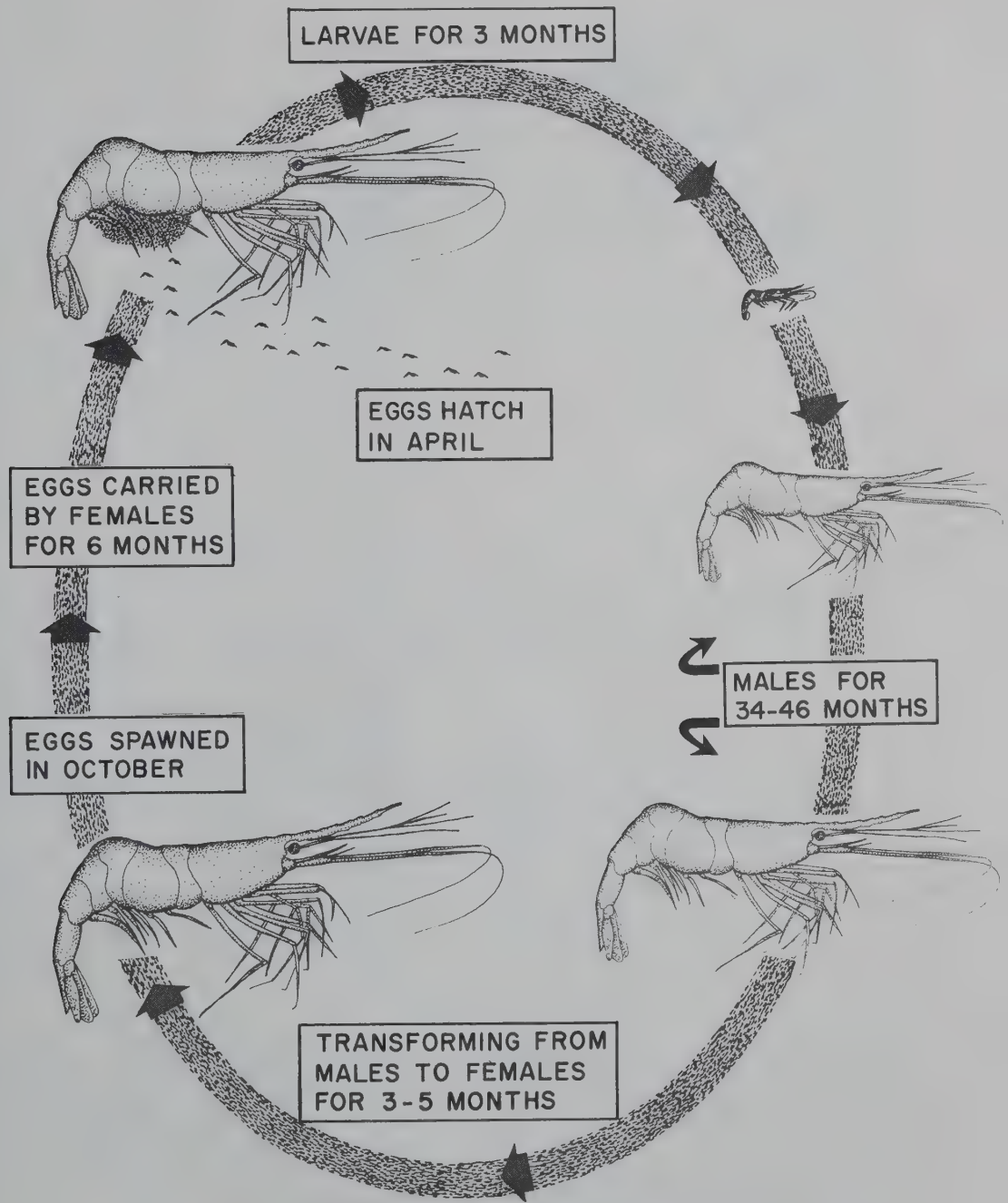

LARVAE FOR 3 MONTHS
EGGS HATCH IN APRIL
EGGS CARRIED BY FEMALES FOR 6 MONTHS
MALES FOR 34-46 MONTHS
EGGS SPAWNED IN OCTOBER
TRANSFORMING FROM MALES TO FEMALES FOR 3-5 MONTHS

Figure 3.--Life cycle of pink shrimp in Kachemak Bay, Alaska.

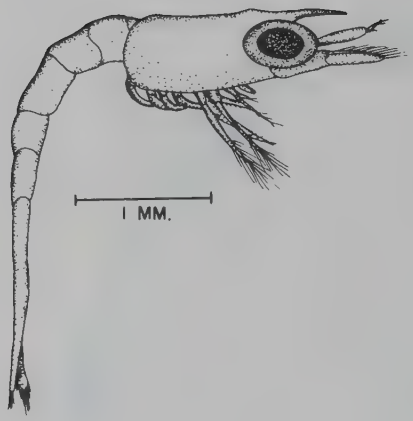


Figure 4.--Larva of newly hatched pink shrimp (drawn from Berkeley, 1930).

with her abdominal appendages at intervals of several minutes. During each "fanning" the larvae which hatched during the preceding few minutes are washed from the egg cluster by the water current and drift away. The shrimp are now on their own.

FOOD

Little is known of the food and feeding habits of pandalid shrimp, but in general they are predators and scavengers. Examination of stomach contents and observations of feeding in aquaria and in the natural environment show that they will eat almost any newly dead animal matter. Pandalid shrimp are also known to capture and eat small crustaceans (including other shrimp), worms, and mollusks.

PREDATORS

Shrimp seem to be choice food for many marine predators. Pandalid shrimp have been reported as part of the diet of such diverse forms as harbor seals and octopuses and are frequently important to many of Alaska's fishes, including salmon and halibut.

THE DOMESTIC AND FOREIGN FISHERIES

Shrimp are caught in Alaska waters by vessels of Alaska and foreign fleets. The boats from Alaska deliver their catches to ports in Alaska for processing; the foreign fishing vessels process their own catch or deliver it to factory ships.

Domestic Fisheries

The commercial fishery for shrimp was permanently established in Alaska in 1916--the catch that year was about 164,000 pounds. This early fishery developed in the Petersburg area of southeastern Alaska. By 1921 the annual catch was over 2 million pounds, and for the next 35 years it varied between 700,000 and 3,500,000 pounds. Up to 1958 almost all of Alaska's commercial shrimp fishing was in the southeastern area.

Shrimp fishing in waters of central Alaska suddenly expanded in 1959 because of the introduction of mechanical shrimp peelers. Landings that year in all Alaska ports totaled 13 million pounds; more than half of this amount was landed at Seward, Seldovia, and Kodiak. From 1960 through 1965 the annual catch in Alaska ranged from 7 million to 17 million pounds, most of which was delivered to ports in central Alaska. In 1966 the fishery again increased markedly and the catch was 28 million pounds. This upward trend continued in 1967 when the total catch was about 42 million pounds. The catch in 1968 again reached about 42 million pounds. Figure 5 shows the principal locations of the domestic shrimp fisheries in Alaska.

Both trawls and baited pots are used in the domestic shrimp fishery (Harry, 1964). The trawls account for most of the catch and are of two general types--beam and otter trawls. The beam trawls are used only in southeastern Alaska. The beam, which controls the width of the opening of the trawl, is usually 32 to 52 feet long. Beam trawlers (fig. 6) generally make 1-day trips and bring in catches up to 10,000 pounds. Otter trawls are used in the shrimp fishery of central Alaska. These trawls average 70 feet wide at the mouth. Otter trawlers (fig. 7) are out about 3 days and usually land catches over 60,000 pounds. Pots are used in southeastern and central Alaska to capture spot and coonstripe shrimp in untrawlable rocky areas. Few fishermen use pots, however, and their catch is but a small part of the total catch of shrimp in Alaska. In 1968 the pot catch was about 73,000 pounds.

Foreign Fisheries

In addition to the United States fishery for shrimp, Japan and the Soviet Union have substantial shrimp fisheries offshore along the

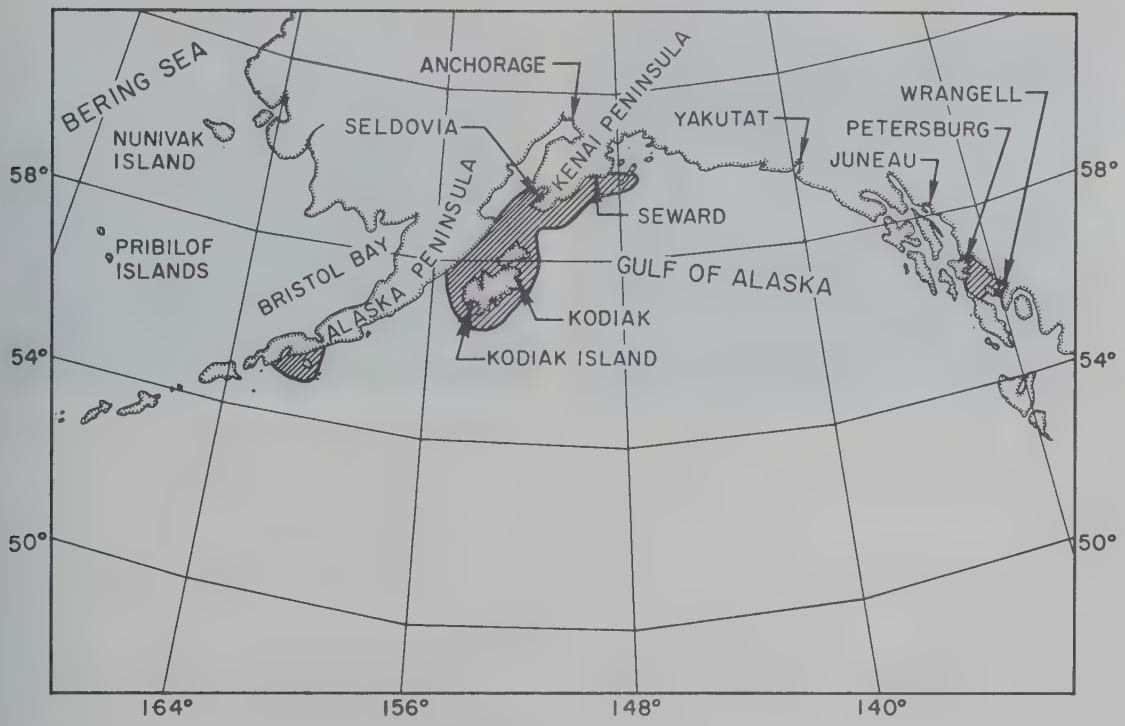


Figure 5.--Areas of domestic shrimp fisheries in Alaska.

coast of Alaska. The Japanese shrimp fishery off Alaska began in 1961 and has been located in the Bering Sea immediately northwest of the Pribilof Islands. The Japanese catch has ranged from 21 million to 70 million pounds a year. The Soviet shrimp fishery off Alaska began northwest of the Pribilof Islands in 1963. In 1964 the fishery moved to the area southwest of Kodiak Island and then expanded to the Shumagin Islands area in 1965. The annual Soviet shrimp catches have ranged from about 1 million to 21 million pounds.

RESEARCH

Four groups conduct research on shrimp in Alaska: Alaska Department of Fish and Game; Bureau of Commercial Fisheries Technological Laboratory, Ketchikan; Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Juneau; and Bureau of Commercial Fisheries Biological Laboratory, Auke Bay. The work falls into four general categories: sampling the commercial catch, improving the product, exploratory fishing, and biological investigations.

The Alaska Department of Fish and Game is sampling the commercial catch in southeastern and central Alaska to obtain information on the species and size compositions of the commercial catches. The State agency also is studying the general biology of the commercial species of shrimp in southeastern Alaska.

The Bureau of Commercial Fisheries Technological Laboratory at Ketchikan is developing improved methods for handling shrimp on the fishing vessels and for cooking, cleaning, and packaging the shrimp.

The Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base at Juneau is searching for new fishing grounds for shrimp in coastal waters of southeastern and central Alaska. Much effort is directed toward locating stocks of spot shrimp which can sustain pot fisheries. This group is also trying to develop shrimp pots which are more efficient than those now used.

Biologists of the Laboratory at Auke Bay are studying growth rates and maturation, ecology, and behavior of the commercially important species of shrimp. This work is done at the Laboratory at Auke Bay and at research stations at Kasitsna Bay on lower Kachemak Bay and at Little Port Walter on southern Baranof Island.

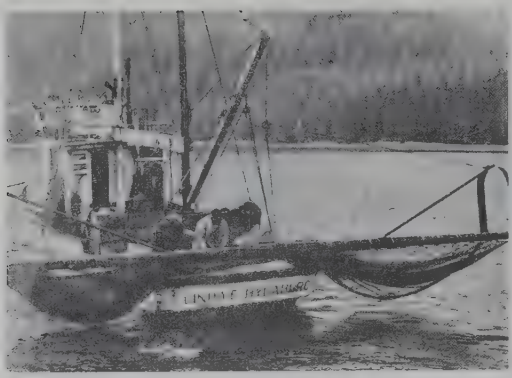


Figure 6.--Beam trawl in operation. Fisherman preparing to release trawl.

Figure 7.--Otter trawl in operation. Trawl has been hauled in over stern ramp.

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